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of Engineers

DCAF Bulletin

Design Construction Analysis Feedback

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CEMP-EC

Subject: Prolonged Mixing of Concrete

Applicability: Guidance

Reference: CEGS 03300, Structural Concrete
CECW 03301, Structural Concrete
CECW 03305, Mass Concrete
ASTM C 94, Standard Specification for Ready-Mixed Concrete
NRMCA QC3, Plant Certification Check List
CRD-C 55, CE Test Method for Concrete Mixer Performance

1. This bulletin supersedes DCAF Bulletin 97-13, dated 7 Nov 97 which is obsolete.
2. It is essential that concrete be thoroughly mixed in order to produce the required properties. It should be uniform in appearance and all ingredients should be evenly distributed throughout the batch. Adequately mixed concrete will yield samples of similar unit weight, air content, slump, and aggregate content in each portion of the batch. It should be noted that this DCAF pertains to normal concrete, and may not be applicable to specialty concretes such as Silica Fume, Lightweight, etc.
3. Prolonged mixing is objectionable. Mixing should not be continued after uniform consistency has been obtained. The grinding action that is part of the mixing process increases the amount of fines in the concrete, generates heat (which raises the temperature of the concrete), and decreases the entrained air. Each of these three factors increases the water demand on the concrete in order to maintain workability, and as a result decreases the strength and durability of the hardened concrete.
4. Most of the structural concrete specified by the Corps is mixed and delivered to the job in ready-mix trucks. ASTM C 94 is the specified standard for ready-mix concrete. Also, the National Ready Mixed Concrete Association (NRMCA) has published a QC manual for evaluating and certifying ready mix plants. All of the features on a truck mixer for evaluating the mixing process have equivalent features on stationary mixers. CRD-C55 is the test method normally used for evaluating stationary mixers. Therefore, control of the mixing process to prevent the effects of prolonged mixing is possible for each type mixer.

5. The following can be used to avoid over mixing:

a. The efficiency of the mixer largely determines the required mixing time. The manufacturer's recommended mixing time for stationary mixers should be closely followed. Normal concrete requires a minimum mixing time of one minute for one cubic yard mixers plus 1/4 minute for each additional cubic yard. For harsh mixes, mixing time should be increased to about 1½ minutes for the first cubic yard.

b. For truck mixers, the number of revolutions at mixing speed should be between 70 and 100. All revolutions over 100 should be at agitating speed. The manufacturer's recommended mixing speed should be between 4 and 18 rpm. Recommended agitating speed must not exceed 6 rpm. Also, batch tickets should be furnished for each batch. Information contained on the batch tickets should be IAW ASTM C 94, Para 13.

c. The concrete should be placed within 1½ hours or before the drum has rotated a total of 300 revolutions. When the concrete temperature exceeds 85°F, the time should be reduced to 45 minutes. Also, high concrete temperature could indicate over mixing.

d. Both stationary and truck mixers must have a metal information plate that lists the operating characteristics for proper mixing of the concrete. In addition, truck mixers should have some means of differentiating the revolutions at mixing speed from the revolutions at agitating speed. This may be accomplished on very large concrete jobs, by specifying that the trucks are equipped with two counters. Since most truck mixers have only one counter, the revolution counter readings may be recorded on the batch ticket: (1) At the first addition of water; (2) At the change between agitating speed and mixing speed; (3) At discharge.

6. Following the above procedures should result in uniformly mixed concrete. If the properties (air, slump, amount of coarse aggregate) indicate that consistency is not being maintained, then over mixing could be the problem. ASTM C 94, Standard Specification for Ready Mixed Concrete contains sampling and testing procedures that the contractor should employ to obtain uniformly consistent concrete. It is the responsibility of the Project Engineer/QA Rep to make sure this is done when required.

7. This bulletin has been coordinated with: Transportation Systems Center, CENWD-NP-ET-E; Technical Branch, CEMP-ET; Operations and Construction Readiness Division, CECW-OC; and Engineering Division, CECW-EG. POC for this DCAF is C. J. Harris, CEMP-EC, telephone (202) 761-8801.



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